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AN APPRAISAL OF LOGGING DAMAGE TO ADVANCE REPRODUCTION OF PONDEROSA PINE

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ABSTRACT

Heavy cutting in ponderosa pine stands in central Idaho caused significantly greater damage to the understory than light cutting. Damage was nearly the same for stands marked by group selection and stem selection, logged by large and small tractors, and with original overstory volumes of 10,000 to more than 20,000 board feet per acre.

INTRODUCTION

Regeneration of logged ponderosa pine stands in the Intermountain Region is often a difficult and expensive operation. Therefore, occurrence of advance reproduction as an understory is a very valuable asset. Where it occurs in sufficient amount and is given reasonable protection, it will insure establishment of the future stand. The great value of advance reproduction emphasizes the need for care in logging the overstory to avoid excessive damage to the understory. The initial logging in an experiment of single tree and group selection cuttings in ponderosa pine in 1953 and 1954 gave opportunity to measure logging damage to advance reproduction and to pole stands as affected by different cutting methods and logging tractors. This note reports the reduction in understory stocking caused by logging.

THE STUDY

The study[1] included 847 acres of the Boise Basin Experimental Forest, Idaho City, Idaho. The area was divided into 16 compartments, each of which was a minor drainage. The 16 compartments included two replicates of eight compartments each, representing the eight combinations of major treatments. The major treatments included: (1) two reproduction methods (stem selection and group selection), (2) two levels of reserve stand volume, and (3) two sizes of logging tractors (D-4 and D-8 caterpillar tractors without bulldozer blades).

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[1] Curtis, James D. A study of ponderosa pine production in central Idaho. U.S. Forest Serv. Intermountain Forest and Range Expt. Sta. Misc. Pub. 4, 9 pp., illus. 1955.

Each of the 16 compartments was also divided into three initial volume classes. These three volume classes, which occupied a minimum of 10 acres in each compartment, were:

Volume class	Initial volume Bd. ft. per acre
I	0 - 10,000
II	10,000 - 20,000
III	20,000 or more

Logging reduced each initial volume class to two levels of reserve volume as follows:

Volume class	High reserve	Low reserve
	Bd. ft. per acre	
I	6,000	4,000
II	11,000	8,000
III	18,500	14,500

Very little logging was possible in volume class I because the initial volumes were so low; therefore, that class was eliminated from the analysis of logging damage.

Sampling Scheme

The damage to advance growth consisted of the reduction in stocking caused by logging. This reduction in stocking was measured in two ways: first, by the reduction of stocked quadrats; and second, by the reduction of poles per acre.

In the first measurement of damage, stocking of seedlings, saplings, and poles was measured on 293 sample plots located randomly in each volume class of each compartment at the rate of one plot for each 2 acres within the given volume class. Each sample plot contained 40 milacre quadrats on which the stocking of seedlings, saplings, and poles was determined. The presence or absence of at least one tree was recorded to determine whether that quadrat was stocked.

The second measurement of damage, reduction of the number of poles per acre, was taken at the same 293 sample plot locations as the quadrat stocking. The number of poles on an 0.08-acre plot was recorded at each location.

Data from measurements of these plots 1 year before logging and 2 years after logging were the basis of the study of logging damage reported here.

RESULTS

Quadrat Stocking

The average percentage of quadrats stocked with seedlings, saplings, or poles before logging, after logging, and destroyed by logging was computed for the four variables: tractor size, reproduction method, reserve volume, and initial stand volume (table 1). Preliminary analyses showed that reduction in stocking was directly correlated with original stocking. Therefore, adjustments were made by the method of covariance analysis before analyzing the effect of the four variables on logging damage.

The level of reserve volume, or the intensity of cut, was the only treatment that significantly affected logging damage to quadrat stocking. Logging damage resulting from heavy cutting (low level of reserve) approached twice that from light cutting (high level of reserve). Heavy cutting required more trips by the skidding tractors to remove more logs. As a result, this cutting reduced the average quadrat stocking

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from 47.63 percent before logging to 39.28 percent, a reduction of 8.35 percent. Light cutting reduced the average quadrat stocking by only 4.76 percent. This difference between levels of reserve volume proved statistically significant only at the 5-percent level of probability.

Difference in damage within each of the other three treatments was small and not significant statistically. Logging damage was nearly the same whether the logs were skidded by a large tractor (D-8) or a small tractor (D-4), when cutting was scattered as in stem selection or concentrated as in group selection, and when the original overstory averaged 10,000 to 20,000 board feet per acre or more than 20,000 board feet per acre.

Table 1.--Effects of logging tractor size, reproduction methods, reserve volumes, and initial volumes on logging damage to stocking of advance reproduction and poles and significance of differences

Treatment	Average percent quadrats stocked: Before logging	After logging	Destroyed by logging	Statistical significance of differences
	Percent	Percent	Percent	
Tractor size				
D-4	44.06	37.41	6.65	N.S.
D-8	45.68	39.22	6.46	
Reproduction method				
Stem selection	46.74	39.75	6.99	N.S.
Group selection	43.01	36.89	6.12	
Level of reserve				
Low	47.63	39.28	8.35	*1/
High	42.12	37.36	4.76	
Initial volume class				
II	41.59	35.47	6.12	N.S.
III	48.15	41.17	6.98	
All treatments	44.87	38.32	6.55	

1/ *The difference between treatments was statistically significant at the 5-percent level of probability.

N.S. The differences between treatments were statistically not significant at the 5-percent level of probability.

Pole Understory

The second measurement of logging damage concerned only the understory pole stands. Pole damage was measured in terms of number of poles per acre before logging and the percentage of poles killed by logging. This measurement differs somewhat from the previous measurement of damage in terms of complete elimination of seedlings, saplings, and poles from a specified area, the milacre quadrat.

The mortality figures showed little or no difference between treatments (table 2). Heavy cutting (low reserve) destroyed 14 percent of the poles while the light cutting (high reserve) destroyed only 10 percent, a difference not statistically significant. All other treatments caused the same degree of damage--12 percent of the poles killed by logging. Although initial stocking of poles varied by treatments, there were no differences in logging damage between the large and small tractor, stem selection and group selection cutting, or high and medium initial volume classes.

CONCLUSIONS

Logging damage to understory stands of seedlings, saplings, and poles was not significantly different for two reproduction methods or for two initial volume classes tested on the experimental area. Damage caused by D-8 tractors was the same as that caused by D-4 tractors. Logging damage varied significantly only with level of reserve volume. Damage was low for all methods of logging and management compared.

The difference between levels of reserve volume could be expected. That is, cutting more timber volume requires more trips by the logging tractors. The extra trips might logically be expected to destroy more of the understory stands. The careful planning and laying out of skid-trails plus the cooperation of fallers and skidders on this sale probably held the damage to a reasonable amount. Fallers were instructed to fall trees uphill or downhill. Cat "skinners" were requested to use the same trail for repeated trips whenever possible. At any rate, it was gratifying to find that heavier cutting need not cause excessive increased damage to advance reproduction.

Table 2.--Effects of tractor sizes, reproduction methods, reserve volumes, and initial volumes on logging damage to poles

Treatments	Average number of poles per acre		
	Before logging	After logging	Destroyed by logging
		Number	Percent
Tractor size			
D-4	196	172	12
D-8	160	141	12
Reproduction method			
Stem selection	186	163	12
Group selection	170	150	12
Level of reserve			
Low	166	143	14
High	190	170	10
Initial volume class			
II	227	199	12
III	128	113	12
All treatments	178	157	12

Little difference in damage was caused by skidding with different sized tractors even though many logs were too large for economical operation of the small tractor.[2] Also, the total damage was nearly the same in stands marked by stem selection and group selection. With stem selection marking, the damage was lighter but covered more area; whereas, with group selection marking, the damage was heavier on clearcut groups but covered less total area.

The careful planning, training, and supervision of the cutting may be largely responsible for the negligible differences between all the treatments. In fact, the most important conclusion from this study could be that if a logging job is thoroughly planned and closely supervised, none of the logging and management methods tested here need result in excessive damage to advance reproduction in typical ponderosa pine stands in central Idaho.

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[2] Wilson, Alvin K., and Gordon H. Greenway. Costs of logging virgin ponderosa pine in central Idaho. U.S. Forest Serv. Intermountain Forest and Range Expt. Sta. Res. Paper 51, 15 pp., illus. 1957.

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